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THE

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REGULAR DEPARTMENTS

SPECIAL ARTICLES

EDITORIAL

THE Bulletin goes to press this month without the supervision of the editor, Mr. W. M. Bostwick, who is at present suffering from an attack of Spanish Influenza. It is satisfactory to know he is recovering and will soon be back at his accustomed post. Mr. Bostwick's many friends will regret to learn that his wife died suddenly from pneumonia following influenza, after about a week's illness. Deepest sympathy is felt for Mr. Bostwick in his sad bereavement.

ATTENTION is directed to the article which appears in this issue entitled "This Matter of Selling Appliances," taken from the *Bulletin* published by the United Gas & Electric Engineering Corporation of New York City.

Most of the Hydro Municipalities have faced the problem discussed in this article, and have decided for or against the selling of appliances. To many towns now considering this very question the able statement of the pros and cons from the standpoint of this New York Corporation will be of great interest. The fact stated that 65% of all the electrical appliances sold are at present handled by the Central Station is very significant.

The editor would be glad to receive comments, preferably in such form as can be published in subsequent issues, if it seems advisable.

Electric Welding

By F. K. DALTON
Assistant Laborarory Engineer

WELDING processes may be defined as the application of intense heat to effect the fusion of metals without causing any change in the chemical composition of the material. Concentration of the heat developed, with the consequent high temperature at the point of application, is the most essential feature in the different processes.

At the present day various methods are used to produce this high temperature, but these may be divided into two distinct classes depending on the manner in which the heat is produced—(a) by chemical action; (b) by passing an electric current through resistance. The methods of welding by means of an electric current may in turn be subdivided into two parts, which, although similar in theory, are vastly different in practice, namely, the resistance method, and the electric arc process.

(*a*)—*By Chemical Action*

Where chemical action is used to produce heat, the processes depend upon the combustion together of two gases under the most favorable conditions. The products of combustion must be gaseous and of such nature that they will not combine with, or otherwise affect the metals being welded or cut. The processes under this heading which are most commonly used employ the "Oxy-Hydrogen" or the "Oxy-Acetylene" flame.

The Oxo-Hydrogen Pracess

Hydrogen will combine chemicaly with oxygen to produce steam, according to the formula

$$2\,H_2 + O_2 = 2\,H_2O$$

To obtain complete combustion and the resultant highest possible temperature, the hydrogen gas must be mixed with oxygen in the proportion of two volumes of the former to one volume of the latter. Pure oxygen and pure hydrogen are manu-

factured and sold in separate tanks in which they are retained until used.

In the operation of this process the gases are led in separate tubes to a nozzle where they are mixed and ignited producing a flame at a temperature of approximately 3500° F.

As the gases are held under considerable pressure they emerge from the nozzle at a fairly high speed producing a long, narrow and very hot flame.

The Oxo-Acetylene Process

Acetylene, being a compound of carbon and hydrogen, will disintegrate when affected by heat, and the elements forming it will each combine with oxygen producing respectively Carbon Dioxide and steam. To obtain complete combustion in this case, two parts of acetylene by volume are mixed with five parts of oxygen, and these combine according to the following formula, producing a flame with a temperature in the neighborhood of 6300° F.

$$2\ C_2H_2 + 5O_2 = 4\ CO_2 + H_2O$$

In this process the gases are handled in much the same manner as in the Oxy-Hydrogen process; the main difference being that the acetylene gas is dissolved in acetone under pressure and as a result much more acetylene may be stored at a given pressure in a tank of a given size.

Here, too, the gases emerge from the double nozzle with considerable velocity, producing a long, narrow and exceptionally hot flame.

As both these "chemical" processes produce a narrow flame, they may be very successfully used for the cutting of sheet metal, making, as they do, a clean, narrow cut throughout the entire thickness of the metal.

It will be noted that the oxy-acetylene flame is hotter than the oxy-hydrogen flame; the reason for this being that acetylene gas is an endothermic compound, the dis-association of the elements liberating considerable energy which also appears as heat and increases the temperature of the flame.

Acetylene can be manufactured much more cheaply than Hydrogen; the fact that a good solvent for it is known and cheaply produced makes it much easier to handle; the flame resulting from the combustion of this gas with oxygen is much hotter than the oxy-hydrogen flame, and in consequence the oxy-acetylene process is replacing almost entirely the oxy-hydrogen processes in the practical application of welding and cutting in the various industries.

It must be noted here, however, that when welding or filling by either of the afore-described processes, it is necessary to feed in the metal required to do the filling. The fact that the gases come out of the nozzle under considerable pressure is somewhat of a disadvantage in welding, as it tends to spread the metal in the part being welded; but in cutting it is a decided advantage, as it helps to keep the cut clear by blowing the metal away as fast as it is melted.

(*b*)—*Electrical Processes*

The Resistance Method.—In a process under this heading, the development of heat is obtained by the passage of an electric current through the parts to be welded or electrodes in contact with those parts. This process cannot be used for cutting.

The temperature can be controlled fairly easily since the heat is developed in the material and is proportional to the square of the current.

Welding, by this method, may be divided under three sub-headings—namely—Butt Welding, Spot Welding and Line Welding.

Butt Welding covers a class of work of the same nature as welding together the ends of bars or rods where the current passes through the bar longitudinally and through the contact between the bars. Contact resistance will undoubtedly cause a concentration of heat at the point of contact which, as it happens, is the place where most heat is required.

The clamps used to connect the metal bars and the supply wires are usually of some metal having a good conductivity.

Spot Welding covers a very useful process used in welding together metal sheets where a continuous weld is not required. In this process the current is passed transversely through the sheets which are held tightly between carbon contacts. The heat is developed by the current passing through the resistance of the carbon blocks and no dependence is placed on the resistance of the metal sheets to develop any further heat.

This method is used only to hold the sheets together, being in effect, the equivalent of flush rivetting but is a much simpler and cheaper process, as no laying out or drilling is required, but considerable difficulty is experienced in obtaining adhesion of plates due to the oxidation which occurs between them. This trouble does not occur with thick material, and may be prevented almost entirely in thin plates by ensuring close contact under considerable pressure.

Only alternating current is used for this work, probably due to the flexibility of adjustment of such a source by means of transformers.

Line Welding, being similar in process to spot welding, is equivalent to a series of spot welds or a line of rivets for strength, but possesses one great advantage over rivetting in ship construction in that the joint is absolutely watertight.

The Electric Arc Process

The electric arc welding and cutting processes depend for their attainment of high temperature on the arc which is formed when a current passes through air or a region of metal vapors. Direct current is used most frequently, but alternating current has been used with more or less success. The method of operation of A.C. equipment as well as the results attained thereby, are so different from the corresponding characteristics of the D. C. equipment that it seems advisable to discuss each separately.

Direct Current Welding. The equipment required for direct current welding may be described under three headings, namely, the generator, the control equipment and the accessories.

The generator is a special machine designed to deliver direct current at 60-75 volts, according to the current capacity, which will be between 200 and 1,600 amperes. All generators used for this purpose are compound wound and may be part of a motor generator set or be belt driven from any capable source running at a constant speed. The amount of current delivered to the arc is regulated by resistance on the panel, there being also an automatic protective device, preventing overload on the generator.

The main switchboard is usually of slate and contains the generator control and the welding circuit equipment for one operator only.

One main board contains:—

1 2-pole circuit breaker;
1 ammeter;
1 voltmeter;
1 field rheostat;
1 dial switch;
1 field switch;
1 protective relay;
1 contractor;
1 series rheostat (mounted separately.)

Auxiliary panels are used in cases where extra welding circuits are required; these contain only the equipment necessary for one welding circuit, namely:—

1 double pole line switch;
1 ammeter;
1 protective relay;
1 dial switch;
1 series rheostat (mounted separately.)

Each outfit requires a number of accessories, some of which are necessary, chiefly on account of the injurious effect on the operator of the ultra violet rays produced by an arc between carbon and iron, or iron and iron. Continued exposure of the eyes to ultra violet light will result in total blindness.

For the protection of the body clothing is sufficient.

In order that the eyes may not be injured, a mask is used. This consists of a fibre tube which will slip over the head and in which is a glass window whereby the operator may observe the work, but which will not transmit the ultra violet light. In some cases this mask is supplanted by a hand shield which is often found to be more convenient, as it can be held in one hand and removed from in front of the face when the arc is stopped. It requires only one hand to operate the electrode.

Electrode holders of two types are used. These are much the same in pattern and purpose, but one type is for carbon electrodes and the other for the thin wire metallic electrode used in welding only. Either type is light in weight and easily handled, and consists of an insulated handle with hand shield and a clamp for holding the electrode.

As we have already stated, two kinds of electrodes are used, *i.e.*, carbon and metallic, the former being solid carbon or rather graphite, the latter being iron, copper or brass according to the nature of the metal being welded.

Carbon electrodes are used mainly for cutting, since no filler is required in the process and the arc is more stable than with the metallic electrode. These carbons are manufactured in several sizes and are chosen according to the current which is to be used in the cutting process:—

Current Used.	Diameter of Electrode.
100 amp.	¼″
300 "	½″
500 "	¾″
1000 "	1″

Satisfactory cutting requires a current in excess of 200 amperes, a lower current being insufficient, but the 300 ampere outfit will do as good work as any higher capacity.

A low current density in the carbon will not heat up the electrode and the arc will have a tendency to travel around, whereas a high current density will overheat the carbon causing it to burn away at an excessive rate.

The following table gives the sizes in which carbon electrodes are placed on the market by manufacturers:—

Diameter Length	Weight per 100 in lbs.
¼ x 12	35
⅜ x 12	90
½ x 12	145
⅝ x 12	220
¾ x 12	300
¾ x 10	275
⅞ x 12	450
⅞ x 10	375
1 x 24	1200
1 x 16	800
1 x 12	600
1 x 10	490
1 x 9	440
1 x 8	390
1 x 6	295

If the electrode holder grips the carbon electrode at such a point that there is a long carbon between the handle and work, a strange action takes place. The carbon wastes uniformly throughout its length in such a manner that after a half hour's run it has assumed a new shape, being of its original length but only about one quarter of its original diameter. By readjustment of the holder, this trouble may be remedied.

The amount of carbon electrode used for cutting is quite variable, depending upon the current strength, method of clamping on the electrode, length of arc held, skill of the operator, etc.

Metallic electrodes are used for welding and filling only, for the melting electrode then assists in the operation.

For welding iron, the electrode is made of the purest iron that it is possible to obtain. It is in the form of round wire, of a diameter depending upon the thickness of metal being welded, which also determines the value of current to be used.

The following table covers "butt" welds in wrought iron and is copied from the *G. E. Review*, June, 1917:—

Thickness of Metal	Diameter of Electrode	Speed Ft. per Hour	Amperes	Mean K.W. at 60 V.
1/16	1/16	20	25–40	1.8
1/8	1/8	16	30–75	3.0
1/4	1/8–3/16	10	70–125	6.0
3/8	3/16–1/4	6.5	100–150	7.5
1/2	1/4	4.3	120–175	8.4
5/8	1/4	2.8	125–195	9.3
3/4	1/4	2.0	125–200	9.6
1″	1/4	1.4	125–200	9.6

Metallic electrodes are furnished either bare or flux-covered as desired, but it is a question whether the flux covering is of any actual advantage.

The heat produces a small pool of molten metal on the parts to be welded, then additional metal is deposited in the molten state from the electrode. With the flux covered electrode, the flux melts with the arc and keeps the molten metal covered with a silicate slag which floats on the surface of the metal. It also surrounds the heated area with an inert gas, thus preventing possible oxidation. When cold, the solidified slag may easily be removed by a wire brush. The flux covered electrode does not demand as good regulation of the current as does the bare metallic electrode.

In describing in general the process of electric arc welding by means of a direct current outfit, it should first be noted that the material being welded forms the positive electrode, properly called the anode. The reason for this is that considerably more heat is developed at the positive than at the negative electrode.

Slow action in welding may be due to reversed connections or to poor contact between the positive lead and the work.

The operator, having his machine running, adjusted to give normal voltage, with all circuits completed, has the electrode holder in one hand, while the other hand holds a face shield, or is free. In the electrode holder he places either a carbon or metallic electrode depending on the class of work he is going to do. He touches the electrode to the "job" at point where he wishes to weld or cut, and then draws back slightly, thus striking an arc.

In cutting, with carbon electrodes, the arc is usually drawn out to about 1 inch in length. No great skill is required in maintaining it as it is most stable.

A 300 ampere outfit will cut steel at the rate of approximately 1½ square inches of section per minute, i e., ½ inch plates can be cut at the rate of 3 inches per minute, 1 inch plates at 1½ inches per minute, etc. This, however, varies slightly with the size of the section and the ease with which the molten metal can get out of the cut.

Equipments of other capacities will cut at a rate proportional to their capacity.

In welding with metallic electrodes, a shorter arc is used and the current is adjusted to some suitable value as shown in the last table given. During the welding action, the melting electrode is used as a filler in this way making it possible to build up parts which have been broken or worn until the piece of work is of such size or shape that it may be machined to the desired design.

Especially useful is this process in railway, ship or gear manufacturing, as it enables the repairing of old parts which would otherwise be thrown on the scrap heap, due to the fact that they required an addition of metal for their repair.

The ability of an arc welding outfit to successfully weld cast iron is frequently questioned. It is claimed that the efficiency in strength

of the best possible cast iron weld is only 75 per cent. The result is usually a very hard central part, but a very brittle region between it and the surrounding unaffected metal. The change of physical state from cast iron to molten iron is much the same as that of ice changing to water, i.e., there is a fixed temperature of fusion, and the iron does not pass through stages of gradually increasing plasticity, but changes completely. It will be realized then that it would be difficult to control the molten metal, and the brittle result obtained when welding is attempted is no doubt due to molten iron solidifying without sufficiently adhering to the original casting.

Excess current produces porous welds, but if the flux-coated electrodes be used, the flux will have a tendency to reduce this effect as well as giving desirable characteristics to the metal.

Alternating Current Welding.—Of recent years, much has been heard of various attempts to apply alternating currents to the process of arc welding and cutting, but the results have not been very satisfactory, the chief reason being the instability of the alternating current arc which at best is limited in length to three-sixteenths of an inch.

There are but two points in which the A.C. arc welding equipment can claim to be of any advantage over the D. C. outfit, namely, overall efficiency and lightness of weight in the apparatus. These are more than fully offset by the many disadvantages which the A. C. process possesses. As before mentioned, the arc is very unstable and it therefore is necessary that a highly skilled operator be employed. Furthermore, an interrupted arc produces a weld which is not homogeneous. Although some work has been done by this process which is comparable with that produced by direct current, yet the work is by no means excellent.

In a previous paragraph, stress was laid upon the fact that the electrode must be of negative polarity, in order to obtain the best concentration of the heat. With an alternating current this is impossible and as a result the A. C. arc with a given current will not be as hot or effective as the D. C. arc. This, no doubt, will reduce the margin of efficiency of the A. C. outfit over the D. C. equipment.

The A. C. arc welding equipment simply consists of a small transformer having a large leakage reactance and designed to reduce the voltage to the desired amount. Its effect on the electrical supply system is generally bad. Under load the primary power factor is very low, about 35 per cent. and the frequent interruption of the arc causes an objectionable winking of all lights on the circuit.

The method of operation is very much the same as with the direct current equipment, and an outfit of this sort may be found an advantage where the matter of delivery in purchasing or portability in operating will counter-balance the various disadvantages.

In comparing the processes described as to their commercial desirable and undesirable features, we see that the gas process is preferably for cutting, that the electric

resistance process is solely of use for welding and that the electric arc process is very convenient for cutting but has its chief use in welding on work requiring filling or a higher temperature than we obtain by the electrical resistance method.

With the gas process, the gas tanks must be transported frequently to and from the gas manufacturer, but the flame makes a clean narrow cut unattainable by the electric arc. It does not deposit carbon in the weld, but always necessitates the introduction of a "filler" when welding.

The electric resistance process can be used for thin sheets only, but the equipment is not large, and may be conveniently transported.

The electric arc process has many parts to get out of order, and requires more skill to operate than the other systems. Initial cost of equipment is high, but the only subsequent costs are for electrodes and for power and these are comparatively small items. Its main advantageous features are the certainty of good work when carefully handled, and speed and convenience in operation.

Cost

Setting aside the electric resistance and A. C. arc processes, it may be of interest to draw a comparison between the costs of operating oxy-acetylene and direct current electric arc methods.

For thin material, the cost of the processes are approximately equal. As the thickness of the metal increases, there is an increasing margin in the cost in favor of the arc process. The same cost applies to cutting by both processes up to about 1½ inch material. Gradually the cost of gas cutting becomes greater than the arc process until for about 6 inch material, the cost is about 60 per cent. greater than the above. This relation, of course, will vary with the type of work, and also with the skill of the operator, but for approximation the above will suffice.

In welding it is found that at about ⅛ inch thickness, the gas process costs are equal to the cost when the arc process is used. As the thickness of the metal increases the gas process suffers by comparison, and from ¼ to ½ inch, the costs by gas are approximately double than when the arc is used.

The following articles are suggested as reference for any person who is desirous of probing farther for information on the subject of electric welding and cutting:—

"Electric Arc Welding," by H. L. Unland, General Electric Review—June, 1917, page 509.

"Arc Welding," General Electric Company's Bulletin No. 48,932—August, 1917.

"Metal Cutting with the Electric Arc," by Graham Kearney, General Electric Review—November, 1917, page 876.

"The Application of Electric Welding to Ship Construction and Repair," The Electrician—August, 30, 1918, page 379.

"Electric Arc Welding," (Historical), by A. M. Candy, Proceedings A. I. E. E.—September, 1918, page 1,159.

Water Power in the Empire

The Need for Development

THE Water Power Committee appointed under the chairmanship of Sir Dugald Clerk by the Conjoint Board of Scientific Societies has issued a preliminary report. It was asked to "report on what is at present being done to ascertain the amount and distribution of water power and its utilization."

The committee has come to the conclusion that the potential water power of the Empire amounts in the aggregate to at least 50 to 70 million h.p., and that much of this quantity is capable of immediate economic development, though only about two millions are now developed. Except in Canada and New Zealand, and to a less extent in New South Wales and Tasmania, no systematic attempt has as yet been made by any Government Department to ascertain the true possibilities of the hydraulic resources of its territories or to collect the relevant data; but as the development of the Empire's natural resources is inseparably connected with that of its water power the latter should not be left to chance, but should be carried out under the guidance of some competent authority.

State Control

The problem of conserving and utilizing the water power resources involves many complex questions of law, of administration, and of engineering and economic investigation if the public interest is to be best served by the development; and in view of the immensity of the interests concerned the committee considers that nothing short of State control is desirable. So far as possible, private enterprise should be encouraged, but under conditions that would prevent the perpetual rights from being lost to the community. Yet while the State should

have the right of ultimate purchase, the period of such purchase should not be unduly short or the terms too onerous.

It is pointed out as worthy of note that Canada and New Zealand have State control over the majority of their water powers, and that in all provinces in India there are Canal Acts which expressly lay down that the Government is entitled to use and control for public purposes the water of all streams and rivers flowing in natural channels. In Australia each State has enacted lengthy legislation in relation to water conservation, but no special clauses appear in respect of developable water power. It is also suggestive that the administration in Washington is at present taking steps to control the development of water powers on all public lands and navigable rivers in the United States; that in spite of the Revolution in Russia the Provisional Government has recently appointed a water power committee with absolute control over all water power schemes exceeding 300 h.p.; and that the Austrian Government during the past Session has introduced a Bill for the promotion of hydro-electric development, giving the State the right to acquire any undertaking after the expiration of 25 years and at the end of any subsequent period of five years.

An Imperial Water Power Board

The Committee recommends that the British Government bring before the notice of the Indian Government, the various Dominion Governments, and the Governing Bodies of the Crown Colonies, the necessity for a close systematic investigation of all reasonably promising water powers and of their economic possibilities, and take steps to ascertain whether the Governments concerned are prepared to undertake this work. When such an enquiry is beyond the power of any Governing Body, the British or Imperial Government should place the work under the direct control of an Imperial Water Power Board or Conservation Commission, and should take steps to initiate the formation of such a body, to include a representative from each of the Dominions and Dependencies. This Board should act in an advisory capacity and should decide on the sequence of such investigation work as comes under its purview. It would be able to take a broad and comprehensive view of the advantages to the Empire as a whole attending the development of any given scheme, and would be able to form a reasonable decision as to the relative advantages of schemes brought forward from different parts of the Empire. Power should be obtained to enable the State to assist or undertake hydraulic development on a large scale, if thought advisable, and much might be done to attract private capital if the State were to guarantee a suitable minimum interest on the necessary capital, sharing at the same time any profits beyond the amount necessary to provide the interest.

Cost of Hydraulic Power

It is emphasized that the cheapness or dearness of energy is purely

relative, and hydraulic powers which are not at present able to compete economically with steam may be able to do so in the not distant future. Even now in favourable localities the cost of electric power generated from hydraulic installations compares favourably with that of steam or oil power. The cost of such power is made up mainly of charges against capital, interest, depreciation, sinking fund charges, taxes, and insurance, which are usually much greater than water charges, and costs of operation, maintenance, and supplies. These capital charges vary widely with local circumstances and the physical characteristics of the site. When the available head is great and the storage reservoir is provided by some natural lake, they may be comparatively small; but where extensive works are required to bring the water to the power house, and where the transmission line is long, the overall cost of power may be largely in excess of that generated by a steam plant.

An examination of some 120 European installations shows that for large examples of over 10,000 h.p. the minimum cost of the hydraulic works is £8.4 per h.p. installed and the maximum £79.6 per h.p. For the majority of the installations the cost lies between £25 and £45. The cost of the electrical plant and transmission lines also varies greatly, ranging from £1.25 to £28.4 per h.p. while the cost of the turbines ranges from £4 to £8 per h.p. The working costs vary between £1.3 and £6.8 per h.p. year, with an average of £3. From these figures it appears that on the average, allowing 15 per cent. for interest and depreciation, the cost per e. h.p. per annum is in the neighbourhood of £10.5. In many cases, however, the cost is very much less. The Ontario Power Company, for example, is able to supply power to the Hydro-Electric Commission of Ontario at £1.8 e. h.p. per annum.

It is estimated that many of the large powers in Canada can be developed at a total cost, including all generating machinery and transmission lines, ranging from £12 to £20 per e. h.p. in which case the cost per h.p. per annum should not exceed £2 to £3.

Need for Preliminary Investigation

Many of the potential powers in existence must of necessity prove economically useless on account of their distance from centres of industry, or the lack of transport facilities or from the fact that the storage required to give a continuous or fairly continuous supply would be too costly. Of many it can be said at once that this is the case, and will remain so for a long period to come, while of others the reverse is true, and it is evident the scheme will amply repay development. But in the majority of cases the extent to which a scheme is capable of economic development can be determined only after a careful examination of the catchment area and the site of the proposed works, after prolonged investigation of the rainfall and run-off records, and, especially, in an undeveloped country, after an investigation of the mineral and forest-

al or agricultural possibilities of the surrounding regions.

When the power is utilized for the supply of some industrial centre, it is true that the usefulness of a water supply depends on the possibility of maintaining its uniformity over the whole period of the year, and that the maximum useful power is strictly limited by the minimum power, which, by the aid of any suggested storage system will be available towards the end of the longest probable period of drought. If, however, this idea were generally adopted it would cut out an enormous aggregate of potential power, more particularly in tropical and semi-tropical countries. The possibility of utilizing flood supplies for seasonal operations in connection with mining, agriculture and forestry or for the production of nitrates, appears worthy of close consideration.—*The Times Engineering Supplement, August, 1918.*

New Humidifer Testing in Evanston

A METER is being set in an Evanston residence for a practical test of an important improved design to control the humidity in houses heated by the average individual plant.

In the cases of steam and hot water heating plants, as is well understood, much difficulty is experienced in injecting into the air of the rooms the moisture requisite for human health and the preservation of furniture. The device referred to is built in some measure on the principle of a thermostat with the important difference that instead of the degree of temperature in the room serving to operate it, the degree of humidity is the actuating energy. If the moisture present is insufficient, the needed action is automatically released. If there is too much further supplies are shut off.

The humidifer as it is called, requires for its operation a boiler in which gas is burned as the fuel.

The Division has made a good record in the sale of electrical appliances this year. The public all the time grows into a better understanding of the convenience and economy of these devices.—*Public Service Lumen.*

It is not too early to make plans for the Christmas season, and already considerable orders have been received for appliances suitable for Christmas trade.

Keep Electric Lamps Clean and Save Light

Week's Accumulation of Dirt Showed in One Case Absorption Equalling 16 per cent.

MANUFACTURING concerns and other customers of Central Stations which light large interiors are having their attention called to the need of maintaining lamps in a clean condition. The effect of not cleaning them regularly is waste.

The grinding rooms of a large establishment, offering average industrial conditions, were made the scene of tests recently.

A group of lamps with a week's accumulation of dirt showed an average absorption of light of 16.3 per cent. with a minimum of 13.3 per cent. and a maximum of 19.8 per cent. Another group which had been used for three weeks had an average absorption of 21.9 per cent., with the minimum 19.1 per cent. and the maximum 26.2 per cent.

Figuring on this basis an increase of over 16 per cent. in wattage at the end of one week, and nearly 22 per cent. after three weeks, would be required to obtain the same illumination as secured when the lamps are clean.—*Public Service Lumen.*

This Matter of Selling Appliances

THERE are a certain number of central stations who refuse to sell appliances. Are they right, and is the trend toward more and better merchandising, which the balance of the industry is now so clearly following, entirely wrong? Or, have they themselves the wrong point of view when they maintain that selling appliances is both unwise and inexpedient? It is a question that comes very close to every United Gas & Electric Engineering man.

It comes close to us because there is a difference right here among the family, so much so that several of our companies have ruled against the merchandising of appliances. They are resigning in favor of the contractor and dealer. Are they right? Are the others all misguided in their policy and short-sighted in the practice of this function? There must be proof of it somewhere.

Why does a central station sell appliances? There are five chief reasons:

1. People whose homes are connected to the lines want appliances. They must have them or they are denied a large part of the benefits of modern electric service. It is, therefore, clearly within the spirit and the purpose of the service which this utility is organized to render

that they should assist the consumer to secure these accessories and enjoy them.

2. Appliances consume electricity and therefore increase the revenue from the customer, so the central station should work to sell more of them and increase the load.

3. Appliances are readily saleable at prices which pay good merchandising profit; therefore, the central station can make money selling them and pay better dividends thereby.

4. By advertising and selling appliances, the central station exerts a more direct and powerful influence for increasing the popularity of these applications of the service than is possible by simply talking of them and not selling them. It educates the public by getting more actual devices into use.

5. By building up the local market for electrical appliances, the central station automatically attracts more dealers into the field and builds up the industry. The contractor begins to sell appliances because he sees that there is profit to be made in it—provided that the central station runs its merchandising business in a business way and sells at list or better and maintains the price that will protect the dealer and encourage him.

Briefly, these are the reasons why at present 65 per cent. of all the electrical appliances sold are sold by central stations; and 65 per cent. is a big majority, a big enough majority to almost standardize a practice and establish it as right. But, on the other hand, the companies that do not sell, are grown men, too. They feel that their policy is best or they would never follow it. Why is it then that there are these other companies that still refuse to sell appliances? There seem to be about four reasons that explain this attitude, this way:

1. In the beginning the central station was organized to generate and distribute electric current. The engineering function was pre-eminent, the commercial function secondary, and there are many managers who feel that the utility should not depart from its strict line of service and sell merchandise.

2. There are many companies who feel that the contractor and dealer should sell the appliances in the community, and they are unwilling to enter the field in either real or apparent competition with them, no matter whether they are adequately supplying and developing the market or not.

3. There are other companies who some time in the past went into the selling of appliances, but were not immediately successful. They overstocked some lines and could not move them off the shelves, or they extended credit with too free a hand and lost money on some accounts. So they quit it in disgust and said: "Let's leave it to the contractor. That's not our game."

4. Then there were other companies still that sold appliances with too little care to maintain the standard of quality. Appliance repairs caused so much discontent among consumers and so much expense and trouble to the company that they also quit.

There in the main is the explanation of why some managers refuse to

merchandise appliances. But in each case their attitude is wrong. They have not reconciled themselves to the new conditions in the industry and moved out into line. And in these war times when the whole world is learning to lay by favorite traditions and face new facts of any kind, the managers who represent this conservative minority must look again. If they are wrong, then they must find out now and make adjustment. If the majority is wrong, then they should prove this fact with figures of experience.

As to these four arguments against the sale of merchandise by a utility, here is the way the majority of the industry feels about it.

1. In the matter of whether or no it is proper for the central station to sell appliances, the answer is clear. A utility is a business. The purpose is to generate and sell electric service. Who says that this service must be restricted to its original conception, that the stockholder shall be denied the extra profit that will come from merchandising all these logical adjuncts to the service? The central station is in business to make money. Why should the manager discriminate against this kind of profit?

2. In the matter of competing with the contractor—after all, what is it that the contractor wants? He wants to make money. He wants to make money on the sale of appliances. Experience shows that he can sell a great many more if the central station will co-operate by advertising and displaying and actively developing the market, maintaining prices and insuring him an ample profit on each sale. He cannot afford to push appliances in a big way. Left alone there is little business, but with everybody in the game and building market there is money to be made.

3. and 4. As to the other cases where they quit because of unfortunate experience with dead stock, bad accounts or repair troubles, those were just faults of business judgment. They need not be repeated. They do not argue against appliance selling now.

And there are other reasons why a central station should maintain a salesroom. People come into the utility office again and again who never notice the contractor's shop in the side street. Is it good service to refuse to sell them the appliances they need, in the more convenient place? Here is the opportunity to reach these countless prospects. Why ignore it? When a customer comes in and wants to buy an iron, he sees there in a glass case, and you refuse to sell it to him, the effect is very bad. He does not understand this way of doing business. He says, "Oh, very well. Just keep your old iron. These people must be nuts." Therefore, whether they expect to sell many or few, to make much profit or little, or whether they care for the added consumption that it brings or not, the central station should sell appliances if only to avoid the bad effect upon the public.

Moreover, men and women in the office who are eager to sell, give more courteous and intelligent service than representatives who have no interest but to answer questions

and get rid of them. This is important.

Also the sale of appliances helps immensely to kill the old idea that the lighting company only thinks about the monthly bill, and how to make it bigger. With merchandise for sale, the central station becomes a human institution, a merchant classified with regular merchants, not just a "soulless corporation," a grasping monopoly. It puts the company regularly into the trade and business of the community. And that this business of merchandising may be made profitable is proven surely by the record of the other companies who have found it so. It is being demonstrated in our own case by the growing profit that is being shown in Merchandising-Jobbing by the United Gas & Electric Engineering Companies who have awakened to the opportunity.

No Commercial Manager should wait a day if there can be a doubt about his non-appliance policy. Service is now selling itself by the pressure of the times. Appliances offer further profit which certainly is sorely needed under war conditions. Washing machines, vacuum cleaners and sewing machines are good for full ten dollars' profit on each sale. Small appliances pay even higher margins. The market is eager for the goods now that domestic servants are so scarce. Dealers are willing to come in and help if prices are maintained at proper scale, and many of them are equipped with salesmen, can carry their own accounts on easy terms, and will restrict their sales to devices approved by the central station. Center your selling effort here, and when the war is over you will have a built-up, going business that will pay all commercial expenses out of its profits, with a residue for dividends.

Here is the question for the manager to ask himself—"Can I conscientiously go before my Board of Directors with my burden of overhead—rent, salaries and all the rest of it—and fail to take this active step to pay my way? Can I call on them to carry this high expense out of the revenue, when I have made no effort to cover it myself with profit from appliance sales?—From *The Bulletin*, published by United Gas & Electric Engineering Corporation, New York City.

Perth, Ont.

Preliminary work has been completed in mapping out the Hydro power site at High Falls, near here. This is the site which Sir Adam Beck announced was to be developed to supply power for the Rideau district. Plans have been decided upon for harnessing this miniature Niagara, and the necessary equipment has been purchased. The High Falls site is one of the most valuable ones to be operated in the Ottawa Valley by the Hydro Electric Power Commission. Work on the power line to Perth has been commenced.

Minutes of Meeting of Executive Committee of Association of Municipal Electrical Engineers

Held at the Office of the Hydro-Electric Power Commission of Ontario, Toronto, September 3rd, 1918

The Meeting was called to order at 7 o'clock p.m.

THOSE present were: Messrs. E. V. Buchanan, Chairman, E. I. Sifton, O. H. Scott, V. S. McIntyre, R. H. Martindale and S. R. A. Clement, Secretary, members of the Executive Committee, and L. G. Ireland and T. C. James, Committee members.

By a resolution of the previous general meeting, a suggestion by Mr. E. V. Pannell, for the formation of a Canadian Institute of Electrical Engineers was referred to the Executive Committee for consideration. The Secretary was instructed to write Mr. Pannell, advising him that the Association did not believe the present time an opportune one for the formation of such a society.

The Secretary then read a letter, dated July 5th, 1918, from Mr. W. W. Pope, Secretary of the Hydro-Electric Power Commission of Ontario, in reference to the name of the Electrical Inspection Department. It was as follows:

"Re Inspection Department

"Yours of the 27th June, addressed to Sir Adam Beck, came duly to hand, and was brought to the attention of the Commission at their regular meeting held on the 3rd inst. I was instructed to communicate with you, and advise that the word 'Hydro' referred to in the resolution has no proper connection with the Inspection Department, as its proper name is 'The Inspection Department,' and it is administered by The Hydro-Electric Power Commission of Ontario, as directed in the Inspection Act."

The Secretary was instructed to write Mr. Pope and advise that the objection was to the use of the name and crest of The Hydro-Electric Power Commission of Ontario on any of the forms or letterheads used by the Inspectors in the performance of their duties; that there is no objection to such use as regards to anything coming from the office of The Hydro-Electric Power Commission of Ontario, but it should not appear on forms used by the Inspectors in dealing with the general public.

Arrangements for the next general meeting of the Association were next discussed.

Moved by Mr. Sifton, seconded by Mr. McIntyre: That the next meeting be held in Toronto some time during January, the date to

be fixed by the President and the Secretary. Carried.

The Secretary was authorized to buy for the Association, an incandescent projector with screen of size and capacity sufficient to meet all conditions, with case and ample supply of spare lamps, fuses and tools to insure satisfactory operation.

Suggestions for papers and demonstrations for the next general meeting were discussed and also proposed arrangements for the entertainment of the delegates.

The Secretary was instructed to write Mr. E. J. Stapleton, Collingwood, who was unable to attend the meeting due to illness, a letter extending to him the sympathy of the meeting and wishing him a speedy recovery.

The meeting adjourned at 8 o'clock p.m.

Eighteen Times More Light than in 1815

A survey of the century of lighting ending in 1815 reveals a marvelous increase in use on one hand and a sharp decrease in cost on the other. But it may be stated, however, this is the result of every inquiry made into almost any manufactured product.

For 40 years after 1815, or until 1855, the average home burned sperm oil and candles, using 25 candlepower per night or 9,000 per annum at a cost of $22. Shortly after this, petroleum was produced in limited quantities, securing kerosene for lighting purposes. This obtained 50 per cent. more light at the same cost.

In the era from 1865 to 1875, kerosene and gas were the illuminants. From twenty to thirty-eight thousand candle hours of one or the other were burned in most homes at a cost of from twenty-three to thirty-four dollars. In the following ten years kerosene was reduced to 22 cents per gallon and gas to $2 per thousand cubic feet. The average family consumption jumped to 76,000 candle power hours per year at a cost of $30.

Between 1885 and 1905, electricity for lighting climbed into its place, and the Welsbach Gas Mantle was invented. In the average house two-hundred thousand candle power hours of light were used each year, but the cost had declined to $20. From the last-mentioned date down to 1915 the average electric candle power hours used fell to 123,000, due to saving through switches and high efficiency lamps. The cost fell to $15.

The maximum light that the average family now uses in the course of a year is 360 candles, or about eighteen times that of a century ago. With the increase of 1,700 per cent. in the amount of night lighting, the reduction in the cost of a year's lighting is about 70 per cent. Expressed in another way, the cost of lighting per unit candle hour is less than 30 per cent. of what it was in the first half of the period.

The Buying of Lamps Under Specification

It is no doubt well understood by all users of Hydro Lamps that they are purchased under specification, and are therefore of assured quality. It may be of interest to sketch briefly the evolution of these specifications.

The Hydro Lamp specifications are, with minor alterations, the standard specifications of incandescent electric lamps, issued by the Bureau of Standards of the United States.

This Bureau was organized by the Government of the United States to develop, construct and maintain standards of measurement, quality, performance and practice, and to apply them for the benefit of the industries and the public.

The specifications for incandescent lamps may be classed among standards of performance, since they deal with those qualities of lamps which determine their performance in service. They were prepared by the Bureau in consultation with representatives of the manufacturers, of the various Government departments and of testing laboratories. They were first adopted in 1907, and have been since revised several times, to be in agreement with the development of the art of lamp manufacture. In drawing up these specifications, it was necessary to determine the minimum length of life which should be required of lamps, and in this connection it was decided that the life of a lamp should be considered as the time required for the candle power to fall to 80 per cent. of its initial value, and the required length of life should be 1,000 hours.

In determining these figures, such factors as cost of lamp, cost of power, efficiency of lamp, were considered, and a variation in any of these factors would manifestly affect the result.

In Ontario, the cost of power is low, and it has been our experience that the 1,000 hour life can be exceeded and economy thereby affected. Hydro Lamps at present

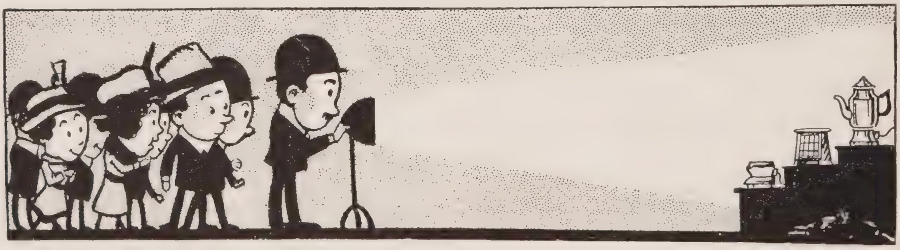
have a life of from 1,500 to 2,000 hours.

Municipal engineers cannot too strongly or frequently impress upon their customers that the Hydro Lamp is manufactured under our own specifications, which safe-guard the people of Ontario, by establishing a standard of performance best adapted to local conditions in much the same manner as the specifications of the Bureau of Standards of the United States Government establishes the standard of performance for lamps in the United States. The Hydro Lamp is manufactured in accordance with the Hydro specifications, and owing to the excellent results made possible by progress in the art of lamp manufacture, our lamps are now sold under a guarantee of 1,500 hours, which to the man on the street means that he is required to purchase only two lamps against three of the 1,000 hour standard.

Mr. O. M. Perry, of Windsor, has furnished the following data in connection with the maintenance of electric ranges on the Windsor System:—

Complete records of 137 ranges are available. These ranges have been in use a total of 2,304 months, have a total of 805 burners, and the number of replacements to August 31st is 201. The average length of time each range is in service—17 months. The number of burners per range changed in 17 months—1.6. In 17 months—27½ per cent. of the burners have been changed. Sixty-one ranges are in service on which no replacements have been necessary. These ranges have been in service on an average of 13 months.

At the 11th Annual Convention of the Canadian Gas Association, recently held at the Windsor Hotel, Montreal, C. C. Folger, General Manager of the Civic Utilities, Kingston, Ont., was elected President; V. S. McIntyre, Manager of the Light Commissioners, Kitchener, Ont., was elected 1st Vice-President; E. H. Caughell, Manager of the Hydro-Electric Commission, St. Thomas, Ont., was elected a member of the Executive Committee of the Association.



Who's Who in Hydro?

H. O. FISK, Manager of the Utilities Commission, Peterboro, was born at Abbottsford, Que., 1866, educated at Abbottsford, and Montreal. In 1885, he entered the employ of the Royal Electric Co., leaving a partly completed course in pharmacy, for this at that time new and attractive work. In 1890, he became Superintendent of the Peterboro Light & Power Co. In 1902 he became Electrical Engineer to the Quaker Oats, Radial Railway and Hydraulic Power Co., the Quaker Oats having absorbed these interests. In 1914, he became Manager of the Utilities Commission of the City of Peterboro, controlleing Light, Power and Water.

H. O. FISK

Enormous Cat Darkens City

It was the "cat" that did it. At a few minutes after ten last night the lights all over the city flickered for a moment and then went out leaving the city in utter darkness An interval of possibly ten minutes elapsed before the street lights came into being again and then, after another preliminary flicker, the house lights came on again in all their brilliance.

It was the result of a short-circuit occasioned by an immense tom-cat, which climbed a pole on the power lines along Arthur street, just east of the Jewish cemetery and made itself into a connection link between the wires that carry 25,000 volts and the ground. It was the last thing that the tom-cat did, and its body was found this morning by the linemen ot the Kaministiquia Power Company lying at the foot of the pole, its nine lives not having availed to save it realize that one cat had been able to bring darkness upon twenty thousand people.—*Fort William Times-Journal.*

HYDRO MUNICIPALITIES

NIAGARA SYSTEM

25 Cycles

	Pop.
Acton	1,570
Ailsa Craig	462
Ayr	780
Baden	710
Beachville	503
Blenheim	1,257
Bolton	727
Bothwell	695
Brampton	4,023
Brantford	26,601
Breslau	500
Brigden	400
Burford	700
Burgessville	300
Caledonia	1,236
Chatham	13,943
Clinton	1,981
Comber	800
Dashwood	350
Delaware	350
Dorchester	400
Drayton	613
Dresden	1,403
Drumbo	400
Dublin	218
Dundas	4,834
Dunnville	3,286
Dutton	840
Elmira	2,065
Elora	1,005
Embro	472
Erin	502
Etobicoke Township	5,822
Exeter	1,504
Fergus	1,679
Forest	1,421
Galt	11,920
Georgetown	1,654
Goderich	4,553
Grantham Township	3,133
Granton	300
Guelph	16,022
Hagersville	1,053
Hamilton	104,491
Harriston	1,563
Hensall	717
Hespeler	2,887
Highgate	427
Ingersoll	5,300
Kitchener	19,380
Lambeth	350
Listowel	2,291
London	57,301
Lucan	643
Lynden	662
Milton	1,947
Milverton	929
Mimico	2,004
Mitchell	1,656
Mount Brydges	500
New Hamburg	1,398
New Toronto	1,423
Niagara Falls	11,715
Norwich	1,093
Oil Springs	537
Otterville	500
Palmerston	1,843
Paris	4,370
Petrolia	3,047
Plattsville	550
Point Edward	937
Port Credit	476
Port Dalhousie	1,318
Port Stanley	849
Preston	4,949
Princeton	600
Ridgetown	2,080
Rockwood	650
Rodney	655
Sandwich	3,077
Sarnia	12,323
Seaforth	2,075
Simcoe	4,032
Springfield	442
St Catharines	17,917
St. George	600
St. Jacobs	400
St. Mary's	3,960
St. Thomas	17,174
Stamford Township	3,418
Stratford	17,371
Strathroy	2,816
Streetsville	500
Tavistock	974
Thamesford	504
Thamesville	742
Thorndale	250
Tilbury	1,605
Tillsonburg	3,059
Toronto	460,526
Toronto Township	5,008
Vaughan Township	4,059
Walkerville	5,349
Wallaceburg	4,107
Waterdown	696
Waterford	1,027
Waterloo	5,091
Waterloo Township	6,538
Watford	1,115
Welland	7,905
West Lorne	724
Wellesley	583
Weston	2,283
Windsor	26,524
Woodbridge	615
Woodstock	10,004
Wyoming	526
Zurich	450
Total	1,101,394

SEVERN SYSTEM

60 Cycles

Alliston	1,237
Barrie	6,866
Beeton	588
Camp Borden	......
Coldwater	617
Collingwood	7,010
Cookstown	......
Creemore	599
Elmvale	775
Midland	7,109
Orillia	7,448
Penetang	3,672
Port McNichol	500
Stayner	990
Victoria Harbor	1,542
Waubaushene	600
Total	39,553

WASDELL'S SYSTEM

60 Cycles

Beaverton	821
Brechin	215
Cannington	746
Sunderland	570
Woodville	357
Total	2,709

ST. LAWRENCE SYSTEM

60 Cycles

Brockville	9,473
Chesterville	854
Prescott	2,630
Williamsburg	100
Winchester	1,065
Total	14,122

MUSKOKA SYSTEM

60 Cycles

Gravenhurst	1,600
Huntsville	2,135
Total	3,735

EUGENIA SYSTEM

60 Cycles

	Pop.
Alton	700
Artemesia Township	...
Arthur	1,003
Chatsworth	286
Chesley	1,975
Dundalk	750
Durham	1,520
Elmwood	500
Flesherton	428
Grand Valley	644
Hanover	3,310
Holstein	285
Horning's Mills	350
Markdale	904
Mount Forest	1,871
Orangeville	2,493
Owen Sound	11,819
Shelburne	1,115
Tara	590
Total	30,543

OTTAWA SYSTEM

60 Cycles

Ottawa	100,561

PORT ARTHUR SYSTEM

60 Cycles

Port Arthur	15,224

CENTRAL ONTARIO SYSTEM

60 Cycles

Belleville	12,080
Bowmanville	3,545
Brighton	1,337
Cobourg	4,457
Colborne	1,012
Deseronto	2,061
Kingston	22,265
Lindsay	7,752
Madoc	1,114
Millbrook	835
Napanee	2,881
Newburgh	444
Newcastle	611
Omemee	446
Orono	700
Oshawa	8,812
Peterboro	19,816
Port Hope	4,649
Stirling	823
Trenton	5,169
Tweed	1,350
Whitby	2,902
Total	105,061

NIPISSING SYSTEM

60 Cycles

Callander	650
Nipissing	400
North Bay	9,651
Powassan	572
Total	11,273

RIDEAU SYSTEM

60 Cycles

Perth	3,358
Smith's Falls	6,115
Total	9,473

ESSEX COUNTY SYSTEM

60 Cycles

Amherstburg	1,990
Canard River	50
Cottam	100
Essex	1,429
Harrow	375
Kingsville	1,633
Leamington	3,604
Total	9,181

THE aim of the Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.